

Notice of Allowability

Application No.

10/711,379

Examiner

David Nhu

Applicant(s)

LU ET AL.

Art Unit

2818

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to 9/15/04.
2. ☒ The allowed claim(s) is/are 1-29.
3. ☒ The drawings filed on 15 September 2004 are accepted by the Examiner.
4. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) ☒ All b) ☐ Some* c) ☐ None of the:
 1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

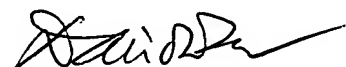
* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
 6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
 - 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
 - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date 01
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____



EXAMINER'S AMENDMENT

1. An examiner's amendment to the record appears below. Should the change and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it **MUST** be submitted no later than the payment of the issue fee.

The application has been amended as follows:

In specifications, page 14, line 59, "photoresist layer 208" should be ~~photoresist 214~~--

REASONS FOR ALLOWANCE

2. Claims 1-29 are allowed.
3. The following is an examiner's statement of reasons for allowance: None of the references of record teaches or suggests as cited in claims 1, 19: forming a spin-on material layer over the substrate, wherein the spin-on material layer completely fills the opening; and performing a plasma etching process to remove a portion of the spin-on material layer and expose the surface of the substrate, wherein the substrate is cooled throughout the plasma etching process so that an etching selectively between the spin-on material layer on the substrate and the spin-on material layer within the opening is maintained to produce a planarized spin-on material layer (as cited in claim 1); forming a plurality of openings in the dielectric layer such that the substrate is divided into two regions, wherein each of the regions has a different density of openings; forming a spin-on material layer over the substrate, wherein the spin-on material layer completely fills the openings; performing a plasma etching process to remove a portion of the spin-on material layer and expose the surface of the substrate, wherein the substrate is cooled throughout the plasma etching process so that an etching selectively between the spin-

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on material layer on the substrate and the spin-on material layer within the openings is maintained to produce a planarized spin-on material layer; and forming a photoresist layer over the substrate (as cited in claim 19).

4. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

5. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure: Hwang (5,753,566): Method of Spin-On-Glass Etch Back Using Hot Backside Helium.

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to David Nhu , (571)272-1792. The examiner can normally be reached on Monday-Friday from 7:30 AM to 5:00 PM.

The examiner's supervisor, David Nelms can be reached on (571)272-1787.

The fax phone number for the organization where this application or proceeding is assigned is (703)872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956

David Nhu



April 27, 2005



DAVID NHU
PRIMARY EXAMINER

location. However, if the substrate has dense via regions and sparse via regions, problems such as inaccurate focusing and deviation in the critical dimension may occur. Yet, similar problems also occur even if the trenches are formed before the via openings.

[Para 51] Fig. 9 is a cross-sectional view of a substrate with a dual damascene structure fabricated using the method according to the present invention. Fig. 9 is a continuation of Fig. 2B where the openings 202 in Fig. 2B are via openings in the dielectric layer over the substrate 200. If the trench is formed first, the openings 202 are trenches in the dielectric layer over the substrate 200. As shown in Fig. 9, a photoresist layer 214 is formed over the substrate 200. Because the step height 210 (as shown in Fig. 2A) between the spin-on material layer 208 in the dense opening regions 204 and the sparse opening regions 206 has already been eliminated, the photoresist layer ~~208~~²¹⁴ has a uniform thickness. Hence, problems including the inaccurate focusing and the deviation of critical dimension in a subsequent photo-expose operation can be avoided. In addition, an anti-reflection coating may be deposited on the substrate 200 prior to forming the photoresist layer 214. On the other hand, if the openings 202 are via openings, an etching back process can be carried out before forming the photoresist layer 214 so that the spin-on material layer 208a is etched to a level at a predetermined distance away from the top surface of the substrate 200.

[Para 52] In summary, the method of planarizing a spin-on material layer according to the present invention is capable of eliminating the steps height resulting from a difference in opening density across the substrate. Obviously, the planarization method can also be applied to coat a spin-on material layer over a substrate with a single opening or to coat a spin-on material layer over a substrate with a uniform opening density. Furthermore, the method of the present invention is able to remove the step heights on the spin-on material layer in a much simpler way than the conventional method so that the processing time is shortened and production cost is reduced. In addition, the method of the present invention also simplifies the processing steps needed to fabricate deep trench capacitor or dual damascene structures